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DEVELOPMENT AND IMPROVEMENT OF PORTS

Guidelines for port managers on the use of computers: Computerized information systems for port operations

Report by the UNCTAD secretariat

CONTENTS

Chapter		*Paragraphs*
	Introduction	1 - 10
I.	Scope and organization of the computing services	11 - 32
II.	Container control system	33 - 72
III.	General cargo control system	73 - 129
IV.	Ships operational control system	130 - 154

Annexes

I. Suggestions for a comprehensive training programme

II. Calculation of check digit for container identification number

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Introduction

1. The first Ad hoc Intergovernmental Group of Port Experts requested UNCTAD to prepare a study on data processing in the domain of port operations and documentation. This was agreed by the Committee on Shipping in resolution 60 (XII), section II. The secretariat prepared a report entitled "Guidelines for port managers on the use of computers" (TD/B/C.4/AC.7/11) which presented an overview of the general issues in the field. This report supplements that first report, providing a more detailed description of the computerized systems for operational purposes and is directed principally at the higher and middle-range managers who plan to use computers in their ports.

2. The report is directed mainly at ports with limited experience in use of the computerized systems. However, ports with some experience in the field can also benefit from the study, comparing their achievements with the scope of the systems described, especially taking into account that the systems described in the report refer to operational activities and the number of such systems implemented in ports is definitely smaller than typical administrative ones (e.g. payroll, accounting, statistics, etc.)

3. The report contains the descriptions of a container control system, a general cargo control system and a system to follow the operations of ships at a port. Each of the systems described also provides basic statistical indicators, e.g. container movement analysis, cargo handling analysis, berth occupancy and time of the operation of the vessels analysis. For calculation of these statistics no special data entry is required. All the indicators are calculated as a "byproduct" of the systems, using data processed for operational purposes.

4. The report also presents some guidelines on the scope and organization of the computing services at a port, including a brief discussion of such topics as the life cycle of the computerized information system, advantages of database packages, exchange of data between port customers and computer department organization.

5. The report does not pretend to be a detailed technical design ready for development of the programmes as this is not possible given the existing variety of organizational, documentational and institutional developments in ports worldwide.

6. The description of the systems follows the functions to be performed rather than any defined organizational model. Some assignments of individual functions to departments or sections named in the report were made to facilitate the description rather than to suggest any organizational solution.

7. The final development and implementation of the systems in an individual port should be preceded by an analysis of the local conditions, and the standard design should be tailored to the local requirements, such as the scope of the tasks performed by the port, documentation requirements, equipment and software available, etc.

8. Successful development and implementation of the computerized systems require appropriately trained staff. Considering this, and taking into account the experience gained by UNCTAD in many developing countries, preliminary suggestions for the type of training activities required in a typical middle-sized port are presented in annex I. UNCTAD is planning to develop training material in the field, subject to availability of resources. Any other training programme developed locally or offered by external organizations would be equally valid, provided that it takes into account the local requirements during delivery.

9. The training seminars envisaged by UNCTAD will be developed, utilizing as a base "Guidelines for port managers on the use of computers" (TD/B/C.4/AC.7/11) and the present study, for senior and middle management of the ports to familiarize themselves with the potentialities offered by the development of computerization in their ports.

10. In addition to training, some countries will also need technical assistance in the implementation of the recommended systems. Such assistance should concentrate on advice and on-the-job training in the organization of efficient computing services at the port and also on the adaptation of the recommended computerized information systems to local conditions.

I. Scope and organization of the computing services

A. Types of computer applications in ports

11. As in any other type of business, the use of computers in ports is increasing. Expanding customer demand, fast development of teletransmission of data in shipping and growing competition among ports force port operators to implement computerized information systems to improve the level of services.

12. There is a wide range of computerized systems installed in ports. The majority of them are used in administrative and financial fields. However, the number of applications in operational processes is growing, especially in those ports dealing mainly with containers. In the administrative field, computers are mainly used for personnel management, payroll calculations, management of spare parts and consumables, a whole range of accounting activities and statistics.

13. In the operational field computers are used for container management, monitoring and analyzing vessel operations, to control the flow of cargo through the port and for documentation purposes. Most of the applications have been developed internally, for port use only, sometimes foreseeing exchange of data with customs or shipping lines. However, a trend to install central data base systems for common use by the port and all its customers can be observed in ports using computer information technology on a larger scale. Such systems usually provide tracing of cargo, required documentation and fast electronic exchange of information among all participants in the cargo movement chain. There are several systems of this type in different stages of implementation in various ports world wide.

B. The life cycle of the computer information system

14. The life cycle of the computer information system consists of various stages. The following is an example of classification of these stages, together with a description of the related tasks:

Feasibility study
Description of existing procedures;
Analysis of alternative solutions regarding different types of equipment and programming tools and also solutions other than computer applications;
Cost evaluation;
Final selection of the solution considering economic (costs and benefits), technical and environmental criteria of evaluation. The solution must provide benefits, be technically possible to develop and operate smoothly in the user's environment. The feasibility study ends with a written report which, after the user's acceptance forms a foundation for further development work.

Analysis and design
Detailed analysis of the existing system;
Analysis of the informations needs;
Definition of the system based upon user's information needs (considers both clerical and computerized procedures);
Preparation of a system specification, which describes the organization of the flow of information, inputs, outputs, data to be maintained, basic processes, control and security procedures. The system specification must be produced in written form, understandable for the user. Technical jargon in the specification is a result of poor communication skill by the analyst and should be rejected by the user. After the user's approval, the system specification forms a base for the further technical development of the system.

Programming
Preparation of detailed technical specifications for programme development;
Programme development and testing;
Final system testing.

Implementation
User training (based on user's manual);
Installation of the system in the user's environment.

Daily operation system Routine operation and evaluation of performance;

Updating and modification of the system according to changing information needs.

15. The development time and quality of the system depends heavily on the appropriate execution of the initial phases of its development. Errors committed in these phases multiply the time and costs of development of the following phases and may lead in the worst case to the abandoning of the system. It is estimated that the analysis and design phase is a source of more than 80 per cent of errors occurring during system development. The cost of correcting such errors may reach up to 95 per cent of the total costs of system development. The present report refers to the analysis and design phase, with the objective of avoiding such errors.

16. Most of the complaints about the use of computer systems refer to:

- The long time that elapses between commencing the work and final system implementation;
- The fact that individual programme development and testing is costly and time consuming;
- The fact that systems in operation are not flexible enough for modification and adjustment according to requirements which change with time.

To eliminate or reduce these problems, a number of tools and techniques have been developed, the most significant being database packages.

C. Basic tools for system development and maintenance

17. Database packages provide facilities to store data and their relationships and provide an effective way for updating and retrieval of the information stored. The main benefits of database packages are that they:

- Reduce data duplication - the same data is validated and stored in one place and is available for all the users;
- Increase consistency of data - all users within the organization use the same information;
- Speed-up system development - existing tools within database packages reduce the programming work required;
- Systems developed are easier to modify - the database concept assumes the separation of processes (programmes) from data so that adding new data to the database will not require any changes to programmes, which is the case when traditional, individual files and programmes are designed.

18. Database packages basically solve one of the essential points of a technical system design which is the organization of storage and updating of data. Usually these main functions are supported with a number of tools to retrieve and process information. Some of them are mentioned below.

Queries - English-like languages for easy retrieval of information from databases by non-technical staff.
Report generators - programming tools for fast output development.
Screen generators - facilitate usage of VDU forms within the system.
Data dictionaries - packages dedicated to maintaining a central catalogue of definitions and data used within the organization.
Fourth generation languages - non-procedural languages at a higher level than traditional programming languages like Cobol, Pascal or Fortran. They are aimed at fast development of complete applications.
Networking tools - facilitate access to/from the database from/to other computers.
High-level language compilers - make possible the use of individually written programmes in languages like Cobol and Fortran within a database package environment. This facility may be required when some system functions are difficult to obtain or are not efficient (lengthy) when using standard database tools.

19. Database packages are sophisticated pieces of software and usually require more powerful equipment (more memory, faster processors) than systems developed traditionally. However,

considering the significant decrease of equipment cost and technical performance offered, the use of database packages should be strongly recommended for systems development.

20. To achieve effective organization of computing services, a common methodology for systems development and maintenance should be established. A methodology for system development is a set of procedures, techniques, tools and documentation aids for helping in the development and implementation of the system. Methodology defines the stages of the computer life cycle and the scope of documentation to be produced. Good methodology provides:

- An accurate record of information system requirements, understood equally by user and system developer;
- A good method for monitoring of systems progress to assure its development within the time and cost limits;
- A good and easy method to maintain the documentation of the system;
- An easy way to learn and use the system.

The methodology for systems development and maintenance, together with manuals of standard administrative procedures, forms a complete set of rules required for the functioning of the Computer Department.

D. Exchange of data with customers

21. Details of containers and cargo carried on board received prior to a vessel's arrival are of great value for advanced planning of port operations. Two types of information are essential, i.e. a stowage plan to determine the position of an individual consignment or container in the ship and a cargo manifest containing a detailed cargo description. Both types of information are more and more commonly available from container operators or shipping lines in computer-readable form.

22. On the other hand, ports having computerized systems can provide information to their customers to facilitate the functioning of their control systems. Final loading/discharging lists, daily movements or periodical inventory lists of containers sent directly to the customer's computer will significantly speed up the flow of information and also eliminate the laborious data entry process. Use of PC-type microcomputers for simple exchanges of information can be an important initial step on the way to more advanced participation in computer teletransmission of data.

23. Computerized telex communication is a simple and cheap way to obtain data transmitted in computer-readable form. There are PC telex packages, which allow the replacement of a standard telex machine with a PC-type microcomputer. The PC is used for sending/receiving telex messages and can also be used for other purposes. Received telex messages are stored in the PC and can be further processed according to needs, eliminating the need for time-consuming manual data entry. As there is no checking of messages for the ordinary telex type of transmission, care should be taken about errors which may occur due to line faults during transmission. Some simple manual procedures should usually be foreseen to assure elimination of such errors.

24. The transfer of files of information between computer systems by sending PC diskettes is another simple way for computer-to-computer communication. As most computers are able to communicate with PCs, it is very possible that the shipping line or container operator involved possesses a system capable of supplying the port PC with diskettes with the required information and of receiving data from the port systems in exchange.

25. Finally, port computers may also be used for direct communication with other computers. The transfer of files can be arranged using the port local network, the public telex or telephone switched network or special high-speed data transmission networks. There is a growing number of bilateral agreements between ports setting up computerized exchanges of information covering ships' sailing/arrival data and cargo carried on board.

26. To facilitate the exchange of the information, electronic data interchange (EDI) standards are under development. United Nations syntax rules for Electronic Data Interchange For Administration Commerce and Transport (UN/EDIFACT) have been developed and published as International Standard ISO 9735. The United Nations Trade Data Element Directory (UNTDED) has also been published, and the major part has been endorsed by the International Organization for Standarization as International Standard ISO 7372. The manual of UNTDED, which is jointly maintained by the United Nations Economic Commission for Europe and UNCTAD, apart from

defining the standard data elements, also contains recommendations for standard codes (e.g. country, locations, packages, documents names, etc.), recommended layouts of trade documents and other recommendations and standards which should be considered when exchanging information whether manually, in documents or using computers.

E. Codes

27. Code files play a double function in the system. They maintain full descriptions of the codes used throughout the system, giving the possibility of substituting full names for codes on outputs (screen/printouts). Codes can also help validate input data, giving the possibility to the programme of checking whether the code keyed in is a valid one, existing in the file. Codes also form a common language for exchanges of information between different systems. Container data cannot be transmitted easily from a container terminal system directly to the shipping lines system and vice versa if there is no possibility of translating codes between the two systems. Container data cannot be transferred directly for invoicing if the invoicing system uses different codes for the same kind of activities as the container system. It is important when planning computer applications to perform an analysis of data and establish a unified code system for the company. Application of international standards approved by international organizations (ISO) is strongly recommended here.

F. Organization of the computing services

28. There are different ways to organize computing services in ports. When the scope of applications foreseen is rather limited and little or no experience exists, computing services can be hired from a specialized local agency. Where the scope of applications is broader, normally requiring greater investment, the setting up of an internal port Computer Department should be considered. Alternatively, a specialized computing company founded by the port and its major customers can be established with the objective of providing computerized services for all parties involved. Such a solution lowers the individual level of investment and facilitates the computerized exchange of informations between customers.

29. The main functions of the Computing Department are the following:

- Planning and acquisition of computing, teletransmission and auxiliary equipment (power supply, air-conditioning, fire protection);
- Planning, development, implementation and further maintenance of computer information systems;
- Assuring an appropriate level of maintenance for all types of equipment;
- Following up the fast changes in information technology and submitting appropriate proposals to the management for implementation.

30. The organizational structure of the Department will be as follows:

- Chief of the Computer Department, reporting to the appropriate divisional director;
- Systems development section;
- Operations section;
- Equipment section.

The following are the basic tasks assigned to each of the sections.

Systems Development Section:

- Analysis of the information systems in co-operation with the management of divisions/departments involved and submission of proposals for improvement of the information systems if application of computers is relevant;
- Development of all stages of the information systems, including their updating and modification;
- Standard software maintenance.

Operations Section:

- Organization of processing of computerized information systems according to schedules and in agreement with operational instructions;
- Maintaining up-to-date systems operating manuals;
- Assuring required consumables and materials necessary for daily operation of the systems;
- Management of data and programmes libraries;
- Assuring appropriate security measures related to data, programmes and equipment;
- Direct co-operation with users and Development Section to evaluate efficiency of the systems in operation.

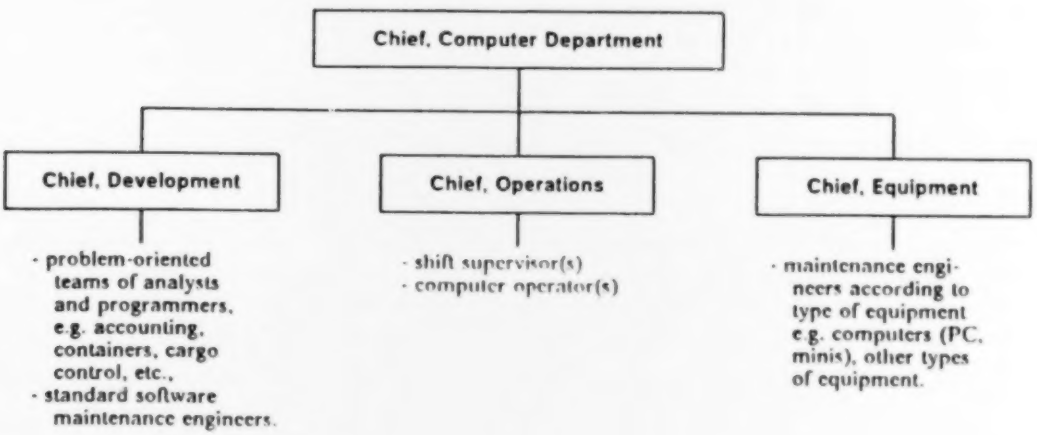
Equipment Section:

- Analysis and evaluation of all types of equipment requirements;
- Direct co-operation with supply department in case of purchase of equipment;
- Assuring appropriate level of maintenance for all types of equipment used by the department either by direct maintenance or use of external services if available;
- Assuring required level of basic diagnostic tools and spare parts required in daily operation of the equipment.

31. The number of employees required to run computing services in a port will vary, depending on local conditions such as the type of equipment used, the number of shifts worked and the type and scope of the systems in use and planned to be developed. For instance, running a container system 24 hours a day on a bigger computer installation with a network of computer terminals will require some computer operators supervising the system during the three shifts, whereas one-shift work with the same system will require a significantly smaller number of staff. When planning the development of a large number of systems, a large number of staff for development and further maintenance of the systems will be required. Additionally, use of computers with very good programming tools, facilitating the fast development of the systems and their further easy maintenance, means that the number of staff for development of the systems can be smaller.

32. There are also some other important factors influencing the number of personnel required such as the skill level of the staff, which depends heavily on the training received, the possibility of hiring external services, etc. To give a rough idea, for a medium-size port starting computerization, to cover the whole range of services approximately 30 employees may be required in the Computer Department. The implementation of a typical set of computerized information systems in ports will normally take a few years. Figure 1 shows an example of a Computer Department organizational structure.

Figure 1
Example of organizational structure of Computer Department


Chief, Computer Department
Chief, Development
Chief, Operations
Chief, Equipment
- problem-oriented teams of analysts and programmers, e.g. accounting, containers, cargo control, etc.,
- standard software maintenance engineers.
- shift supervisor(s)
- computer operator(s)
- maintenance engineers according to type of equipment e.g. computers (PC, minis), other types of equipment.

II. Container control system

A. Needs for computerized control system

33. The rapid development of containerization in sea transport over the last two decades has had a significant influence on the application of computerized information systems in ports. Large investment in the development of specialized container terminals has increased the speed of the flow of cargo to the extent that large container vessels carrying a couple of thousand containers on board can be discharged/loaded within 24 hours.

34. This fast flow of cargo requires, in parallel, a fast flow of information, including quick preparation of the appropriate documents. This cannot be achieved in the conventional, manual way and that is why container control systems are given high priority among operational computer applications in ports.

35. With a throughput of approximately 120,000 containers per year for 24 hour-a-day and seven day-a-week working, but assuming delivery and reception for only five days a week and eight hours per day, the terminal will receive and deliver on average almost one container every minute. It also means that if transport is done by road, and assuming all FCL boxes, a truck enters or leaves the terminal every 30 seconds (empty in, full out or full in, empty out).

36. The short time spent by vessels in the terminal requires that special emphasis be placed on receiving details of containers carried on board in advance, prior to the vessel's arrival, to minimize the stay in port. Hence, the development of containerization is accompanied by the application of computerized teletransmission of manifests and stowage plan details from the port of loading to the port of discharge. Transmitted data are used to plan discharging operations, as well as to print required import documentation. For a container terminal to be managed successfully, accurate and current information on all container operations is essential.

37. A properly designed computerized container control system increases the operating efficiency of the terminal. The main benefits provided by such system are the following:

- Faster discharging and loading of containers;
- Increased productivity through faster turnround of containers;
- Better monitoring of the storage of containers;
- High level of accuracy of information;
- High level of consistency of the information used by various departments of the terminal;
- Relief of the pressure on documentation and clerical duties;
- Better service for customers through more accurate and quickly obtained information about desired containers;
- Speeding up of invoices and thus income, if defined routines exist to translate operational events recorded in the computer into charges to the customer.

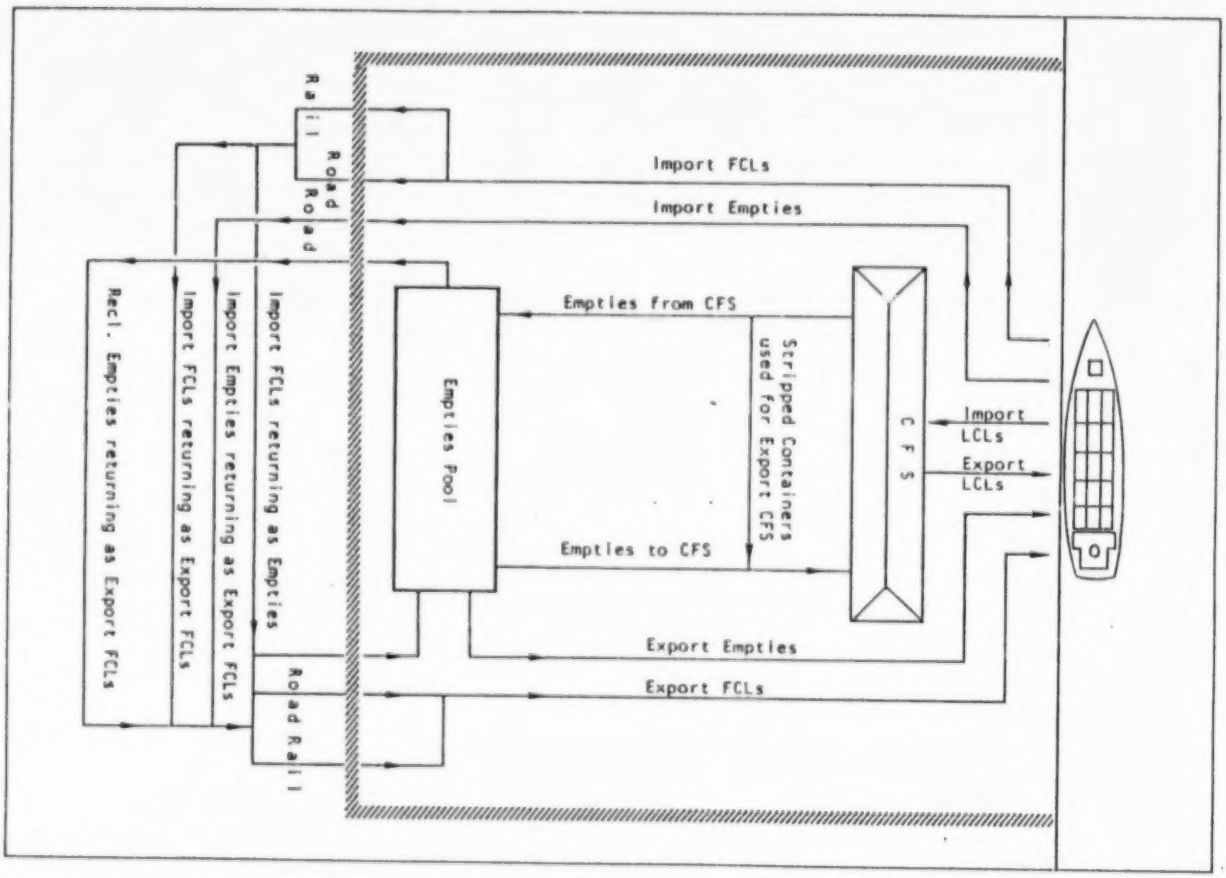
B. Objective and scope of the system

38. The main objective of the container control system is to help operational staff in the efficient management of the flow of containers through the terminal. The principal functions of the system are the following:

- To keep an up-to-date record of the containers in, or due to arrive at, the terminal;
- To provide operational staff with current information required in their daily job, e.g. location of the container, time of storage, customer involved, etc.;
- To issue reports and documents required in daily operations;
- To maintain archive information for possible claims and periodical analysis of performance of the terminal;
- To provide source data for invoicing purposes.

39. The possibility of direct issuing of invoices based on data recorded within the system depends on the structure of the tariff in use. Generally, if the rules for invoicing are based upon the length of stay of containers at the terminal and the type/quantity of their movements, it is feasible to issue invoices directly from the system. The control system is built around a basic sequence of movements of containers within a terminal, as shown in figure 2.

Figure 2
Container flow chart



Import sequence:

- Receiving stowage/manifest information prior to the vessel arrival;
- Preparing discharging of the vessel;
- Discharging of the vessel;
- Delivery of containers to consignees or to CFS if LCL container.

Export sequence:

- Receiving containers for export from inland or CFS;
- Obtaining loading list and stowage plan from shipowner or his agent;
- Plan and prepare loading sequence;
- Loading of the vessel.

Empty movements:

- Receiving of empties from the vessel, inland or CFS;
- Delivering empties to vessel, inland or CFS.

Yard internal movements:

- Changing the position of containers within the yard for various reasons, e.g. manipulations to prepare loading/discharging of vessels, transfer of containers to the CFS area, etc.

40. Depending on the number of containers handled, three types of typical data processing systems can be considered which for the purpose of this report can be described as follows:

(a) Off-line central system;

(b) On-line multipoint system;

(c) On-line multipoint system with direct telecommunication to yard mobile equipment.

The first type of system, the simplest one, records the container movements centrally, usually in the operations centre of the terminal, following the same rules for the flow of information as in manual, board or card file systems. Instead of writing/updating control cards, the information is recorded in computer files.

41. The advantage of such a system over a manual one is that data can be automatically validated during data entry, assuring a higher level of accuracy of information. The system provides easy retrieval and reporting of information on containers. Information accumulated for control purposes can be used for automatic calculation of statistics. The system may run on an ordinary PC microcomputer, and can be developed using simple and cheap database software easily available in the market.

42. As the computer is located centrally, no direct access to the system is provided at the gates and other points dealing directly with customers and documentation. Data entry is based upon manually prepared documents which are sent after operational usage to the computer office. Hence the records in the computer files are behind the physical movements of containers. The difference in time between computer files and the real positions of containers depends upon clerical efficiency in receiving and transferring documents into the computer files.

43. The second type of system consists of a multipoint system giving direct access to the computer from the points where movements of containers take place. The important locations to be considered are as a minimum the gates, the yard operation section, and yard and ship supervisors' offices. As all these locations have computer terminals which give direct access to the same common files, the information in the computer is more up-to-date. Better control over data entry can be assured, providing a high level of accuracy and consistency of information.

44. Such systems are much more efficient than the first ones. However, they require more investment in both equipment and development of the software. Usually they are based on minicomputer equipment offering fast access to the information for at least 10 - 20 terminals working simultaneously. Average disk memory requirements are between 100 and 200 Mb and depend upon the particular software facilities offered and the detailed technical design of the system. As an alternative solution to the minicomputer, a fast network of microcomputers can be considered.

45. The third type of system consists of the system described above, offering in addition possibilities for yard operation staff to communicate via the computer with drivers in the mobile yard equipment. Drivers' cabins are equipped with visual display units (VDU) and simplified keyboards. The driver receives on the VDU an order to move a container (e.g. the container number, its position in the yard, the position to which it is to be moved) Confirmation of the execution of the order on the driver's keyboard causes automatic updating of the layout of containers in the computer files. This solution makes it possible to follow container movements in the yard very closely and also facilitates execution of loading/discharging operations. Radio transmission is the most common means of communication for this type of system.

46. All three types of system described above are based on the same central function - tracing the container according to its movement through the terminal. Apart from the different investment levels required in each case, from the point of view of the user the basic difference is the time gap between a container move and its reflection in the computer files. In the first type of the system this gap would be largest and in the last one it should be the smallest. The smaller the time gap, the more beneficial the system will be for the direct work of the operational staff.

47. The basic information required as inputs to the system, as well as the principal outputs, remain the same, independent of the alternative chosen. However, the organization of the flow of information is different. The following more detailed description of the system is based on the assumptions most commonly applied for a medium-size terminal system, defined above as the on-line multipoint system.

C. Basic assumptions and definitions

48. The following assumptions are made for the further description of the system:

- There exists a documentation section responsible for keeping records of receptions/deliveries of containers and associated documents at the terminal, as well as for recording and controlling execution of customers' orders. This section is responsible for data entry of the information at the gates, as well as manifests and loading lists received from shipping lines;

- The yard operation section is responsible for direct container stacking operations (e.g. giving instructions to the terminal drivers) and for tracing the positions of the containers within the yard;

- The yard and ship supervisors plan all movements of the containers within the terminal;

- The system is equipped with a minicomputer or an equivalent microcomputer network, with the required number of computer terminals (visual display unit (VDU), keyboard, printer). The terminals are located in the documentation section to support receiving/delivery and loading/discharging documentational procedures and in the yard operation section for direct recording and control of the yard movements. The ship and yard supervisors' offices are also equipped with terminals for planning loading/discharging operations;

- During gate operations an Equipment Interchange Receipt (EIR) is printed by the computer. An EIR is a written confirmation of the exchange of a container between the terminal operator and the carrier at the gates;

- The movements of containers are carried out on the basis of written requests by the customers, unless the shifting of containers is done for internal purposes, e.g. to consolidate space, to retrieve another container, etc;

- The Container Freight Station (CFS) consists of a transit shed where import LCL containers are stripped of cargo and where export cargo is stuffed into LCL export containers. Normally, when a container control system is developed, a cargo control module for the CFS is also included (if the CFS forms an internal part of a terminal). A CFS control system follows the rules for management of a conventional transit shed and is not described here;

- Clear marking of the yard is one of the most important prerequisites for efficient computerized control of containers. This is of the same importance for specialized container terminals as for separate zones for storing of containers in conventional cargo terminals. One of the more common systems of stacking of containers consists of blocks, usually marked with letters (A,B,...). Each block consists of rows, bays and tiers. Position B 15 06 3 can be read as block B, 15th row of the block, 6th bay in the row, 3rd tier;

- Standard container identification rules (ISO 6346-1984(E)) are an essential part of any container control system.

  The container identification system consists of:

  Four letters - owner code;
  Six numerals - serial number;
  One numeral - check digit.

  The owner code consists of four capital letters of which the fourth must be U. The owner code should be registered with the International Container Bureau in Paris, to assure unique identification of the owner.

  The serial number consists of six digits filled up with leading zeros if necessary (000235).

  The check digit provides the possibility of automatic validation of identification of a container during data entry or teletransmission. Calculation of the check digit is based on the owner code and the serial number. Annex II shows how the check digit is calculated.

Computerized control of the check digit during data entry is a very fast and efficient method for the elimination of almost 100 per cent of errors originated by the incorrect reading of container identification.

D. Organization of the flow of information within the system

Discharging of the vessel

49. Prior to a vessel's arrival, on the basis of the stowage plan and cargo manifest, a discharging list is obtained from the shipping line or its agent. The list, if obtained by mail, should be keyed into the computer. If received directly in computer form the list is printed out and serves as a basis for preparation of a discharging plan. Containers expected for discharging are recorded in the system.

50. During discharging, the list is verified, the technical status and seal numbers of containers are checked and the yard stacking position is fixed. All these data are recorded in the computer files by the yard operation section staff, either during or immediately after discharging. At the end of vessel working, the discrepancy report is produced by computer showing the differences between the containers expected (manifested) and those discharged.

Loading on board

51. The terminal receives a loading list from the shipping line stating the vessel/voyage number, and a list of containers grouped by port of discharge. On the basis of this list, the loading plan is elaborated and printed out. The plan is prepared with the direct participation of the shipping line. During or immediately after finishing the loading operation, containers loaded on board are marked in the computer files as loaded and the final "loaded on board" list is printed and transmitted to the shipping line or its agent.

Delivery of full/empty container to customers

52. The shipping line or an authorized agent issues the order to deliver containers to a customer. This is recorded in the computer. The haulage driver arrives at the gate with the required clearance documents. The gate clerk checks the documents, checks with the computer the location of the container and instructs the driver where to go in the yard to collect the container. Alternatively, if a special interchange point is organized, the container is taken by the yard equipment to this point and collected by the driver.

53. When passing through the gate, the container is physically inspected, the results of the inspection are keyed into the computer and an Equipment Interchange Receipt (EIR) is printed on the gate terminal, describing the technical status of the container. Computer files are updated by the gate clerk with the date and hour of delivery, technical status, haulier identification and EIR number.

Receipt of empty/full containers from inland

54. Information about containers to be received, both empty and full, should be provided in written form prior to their arrival at the terminal. In the case of full containers, details of the vessel, voyage number and port of discharge are required. This is recorded in the computer and can be checked when containers arrive at the gate. Upon the arrival of the container, an EIR is produced and data similar to that entered on delivery are recorded in the computer by the gate clerk.

Internal movements

55. Internal movements, such as positioning of containers for stripping or stuffing in the CFS area, are interpreted by the system in a way similar to the delivery/reception of the containers to/from inland. To facilitate co-operation between the container terminal and its principal customers, the main shipping and forwarding agencies involved in container traffic can be equipped with computer terminals connected to the container terminal system. Customers can enter the orders for container movements directly and review the current status of their containers.

E. Brief characteristics of basic outputs

56. On-line enquiries can be made via the visual display unit for operational purposes by documentation clerks, ship and yard supervisors and yard operation section staff. These enquiries permit the entering of corrections or updating of files. The enquiries allow the records in the files to be reviewed and facilitate:

- Reviewing the current position of containers, together with related import/export data;
- Reviewing the sequence of the internal movements at the yard;
- Loading list and manifest data revision and update;
- Reviewing historical data of containers which have left the terminal during the last 2-3 months.

All data displayed on VDU can be printed on the printer attached to each VDU. An Equipment Interchange Receipt is printed during gate-in/out operations.

57. Printouts on request:

- List of container movements by customer. The list is produced on request for daily control purposes by the terminal or customers. It can also be used for invoicing purposes. Basic data: customer, type of movement (gate in/out, internal movements), container identification, size/type, order number, loading status (FCL, LCL, empty), direction (transit, transshipment, import, export), technical status, gross tonnes, stacking position in the yard, vessel, voyage number, port of loading/discharge, clerk involved;

- Current status of containers in the terminal by selected parameters: customer, and/or container owner code, and/or loading status, and/or direction, and/or type of movement. Produced for daily control purposes. The scope of the information as in the list of container movements;

- Container yard layout. Printed for inventory control purposes as well as for planning operations within the yard. Container identifiers, together with their loading status, are printed according to their position in the yard (block/row/bay/tier number);

- Containers by customer according to time of storage. Printed usually on request of customer involved or for billing purposes. Printout is organized by customer, loading status, date of entry into the terminal and container identification. The scope of the data is as in the list of container movements;

- Containers with special cargo (dangerous, reefer). Printed for daily control/operational purposes. Organized by type of cargo, customer, container size and type and containers identifiers. The scope of the information is as in the list of container movements;

- Register of orders for container operations. Printed for daily control of the execution of customer orders. The printout presents orders received, executed and pending in the required period of time by customer and/or order number. Basic data: order number, customer, date/time received, date/time executed, invoice number if issued, container identification, type, size, type of cargo, gross weight, vessel, voyage number.

58. Printouts according to ship's call:

- Discharging list and discrepancy report. Printed at the end of discharging operations to list containers discharged at the port. Printout is organized by vessel, voyage number, port of loading, direction, loading status, container identification or alternatively vessel, voyage, container identification. Basic data: Vessel, voyage number, container identification, size, type, bill of lading number, loading status, direction, type of cargo, IMDG class if dangerous, technical status, seal number, port of loading, customer involved, date discharged, gross tons, remarks if container not announced in discharging list received from shipping line. The list ends with containers expected but not discharged.

- Loading list and discrepancy report. Printed at the end of loading operations and lists containers loaded on board. Printout is organized by vessel, voyage number, port of discharge, container ideidentification. Basic data: vessel, voyage number, container identification, size, type, loading status, type of cargo, IMDG class if dangerous cargo, gross tons, technical status, seal number, customer involved, date loaded, remarks about con-

tainers loaded and not present in loading list. The list ends with containers in loading list but not loaded.

59. Monthly statistical printouts:

The outputs are produced on the basis of inward/outward movements for each ship's call within a month. Accumulated monthly data can be printed as an annual report.

- Number of teu handled (ISO size converted into 20 foot);
- Number of containers handled by ISO size, type classification, according to direction of traffic (import, export, transit inward, transit outward, trans-shipment) and loading status (FCL, LCL, empties);
- Number of teu handled, organized as in the previous report.

F. Brief characteristic of basic inputs

Stowage plan and import manifests

60. Basic data: vessel, voyage number, agent, port of loading, container identification, size/type, stowage position, gross tons, loading status, direction, IMDG class for dangerous cargo, seal number, bill of lading number, type of cargo.

Loading lists

61. Basic data: vessel, voyage number, agent, port of discharge, container identifications, loading status, type of cargo.

Orders from customers to operate containers

62. Basic data: order number, date/time of receiving, customer identifier, customer reference, description of operation required.

Gate-in/out moves

63. Basic data: order number, container identification, loading status, direction, technical status, seal number, EIR number, gross tons, type of cargo, date/time of gate-in/out, gate clerk involved, for export containers vessel, voyage number, port of discharge.

Internal yard movements

64. Basic data: order number, container identification, current position of the container in the yard, date/time, yard operation clerk.

G. Basic files of the system

Manifest file

65. This file maintains the information about containers expected to be discharged from a given vessel/voyage number. Containers are introduced into this file either by directly processing information received from teletransmission or by keying in the required data from the received stowage plan and cargo manifest. Basic data: line, vessel, voyage number, port of loading, container number, type/size, stowage position, gross weight, loading status (FCL, LCL, empty), type of cargo, IMDG class, seal number, direction, bill of lading number. The information in this file is maintained until final vessel clearence.

Loading list file

66. This file contains a list of containers to be loaded on board a given vessel. It is created on the basis of data received from the shipowner. Basic data: vessel, voyage number, port of discharge, container identification, size/type, loading status, type of cargo. The file is maintained for control purposes until final vessel clearance.

Container file

67. This is the main file of the system containing records of all containers currently within the terminal. It contains all data referring to reception/delivery, loading/discharging of containers and internal yard movements ordered by customer (e.g. positioning in CFS). Updating of this file is done by the documentation section on the basis of the documents accompanying the movements of containers. Basic data: container number, size/type, direction, loading status, customer responsible for container, customer order number, EIR number, technical status, seal number, date, hour, type of movement, type of cargo carried, vessel/voyage number, port of loading, port of discharge, documentation clerk involved. The information in this file is maintained while the container stays in the terminal. After the container leaves the terminal, relevant information is moved into the archive file.

Yard file

68. The objective of this file is to keep an up-to-date record of the container's position within the yard, as well as to keep a log of container movements within the terminal. The file is updated during the daily work of the yard operation staff via VDUs in the operations room. Basic data: container number, date/hour, stacking position and customer's order number if movement is performed on request of a customer, yard operation section clerk involved.

Containers expected - inland

69. This file contains information about containers expected in the terminal either as empties (after being stripped in customers' premises) or full for export. The file is updated on the basis of information from the shipping line or an agent working on behalf of the line. The objective of this file is to give the possibility of recording information prior to containers' arrival from inland to speedup procedures at the gate. Basic data: container number, size, type, date, loading status, vessel, voyage number, port of discharge if applicable, haulier identification. The information in the file is maintained until reception of the container at the terminal.

Customer's order register file

70. This file contains all orders from customers to perform movements of containers. Such orders when accepted by the terminal are recorded in the file and form the basis for execution of the movement. This file, together with the Container File, can also be used for invoicing purposes. Basic data: order number, type and description of operation required, date/time received, customer reference, date/time termination, invoice number, remarks containing any important information relevant to execution of the order.

Archive file

71. For the calculation of required statistics as well as for reasons of possible claims, after the container has left the terminal, information from the Container File of the system is transferred to the archive file. Normally such data is kept on line for 2-3 months after the container leaves the terminal as the majority of requests for archived information occur within this period of time. If required, further storage of archived data in an off-line manner should be foreseen.

Code files

72. Basic codes within the system:

Ship code - Lloyds Register number or radio call code for the ships calling at the port;
Port codes - based on ISO country codes and IATA location codes;
Container size, type - according to ISO codes;
Loading status - FCL, LCL, empty;
Technical status - good to use, for repair;
Direction - import, export, trans-shipment, transit;
Type of cargo - dangerous, reefer, other types;
Type of movement - movements of containers recorded within the system: received, delivered, loaded, discharged, positioned in CFS, received from CFS, internal yard shifting according to desired types;
Customer codes - mnemonic or numerical codes assigned to port customers involved in container movements (agents, shipping lines, forwarders etc.);
Dangerous cargo code - according to IMDG dangerous cargo classifications.

III. General cargo control system

A. Need for an efficient information system

73. The general cargo terminal is designed to accommodate a variety of cargo organized in different unit loads of different size, weight and type of package. Export cargo is often received a few days and sometimes a few weeks prior to the vessel arrival. A large portion of import cargo is stored in the port before its further distribution to the hinterland by various means of land transport. This necessitates having enough storage capacity to accommodate both import and export cargo. When larger volumes of cargo than planned capacity are involved, congestion in storage areas can occur, having a negative influence on cargo-handling performance and berth throughput.

74. It is estimated that approximately 60 per cent of the land area in ports is used for storage purposes. Keeping track of many shipments, providing the necessary documentation and controlling the use of space within the sheds requires competent management, supported by a good information system in which the computer plays an essential role.

B. Objective and scope of the computerized information system

75. The principal objective of the system is to provide operational support to the management responsible for cargo handling, considering both planning and supervision of cargo storage at the general cargo terminal and also direct shed/yard/warehouse storage management. At the terminal level the system can be used as a working tool for shed supervisors to plan cargo-handling activities and for direct monitoring, via computer files, of the use of the storage facilities. At the shed level the system is a tool for the shed documentation office, providing an easy way of maintaining detailed records of cargo movement through the storage areas.

76. The basic tasks of the system are the following:

- To keep an up-to-date record of individual shipments passing through the storage areas (sheds, warehouses, yards);
- Providing fast, on-line information about cargo stored, including its description, location of storage, time of storage, customers involved, etc.;
- Providing information about available storage capacity;
- Providing statistics of cargo flow through the terminal;
- Providing source data for invoicing.

77. When storage dues are calculated on the basis of the data recorded within the system (in general terms this data consist of time of storage and quantitative description of the cargo), direct issuing of the invoices from the system can be considered. This will speed up the flow of money and reduce significantly the clerical effort required.

78. The scope of the system may be reduced to a simple inventory system for the main individual sheds/yards/warehouses within the terminal or may cover all storage facilities providing also direct, on-line access to the computerized information for the shed supervisors responsible for planning and general storage supervision at the terminal.

79. In the first case, a PC-type microcomputer installed in each shed documentation office will probably solve the problem. The system will act as a direct tool for the management of individual sheds or, if one documentation point for a group of sheds exists, a computer will keep records of the cargo movements for this group of sheds. No direct, computerized access to the shed information for terminal storage supervisors is provided.

80. In the latter case a minicomputer installation with a network of computer terminals installed in the sheds and in the shed supervisor's office at the terminal can be considered. Both the shed planning/supervising office for the whole terminal and also individual shed offices use the same common information for their daily work, reducing needs for the manual preparation and exchange of data between the two levels of management.

81. Alternatively, the system may be developed in stages, installing firstly PC-type computers for individual shed management purposes and in the final step merging all PCs into a network in which

the shed supervisors for the whole terminal will also be included. Final selection of the scope of the system and the way of its development depends on local organizational conditions for cargo handling and should be preceded with appropriate analysis, considering also a cost benefit evaluation.

82. The principal part of the system refers to control of cargo flow through the sheds and open storage areas (yards). Shed/yard documentation sections responsible for keeping registers of cargo and documentation procedures enter into the computer details of each consignment reception and delivery. The scope of the information required is very similar to that usually recorded in the manual register by the shed clerk. This results in an up-to-date computerized inventory file of cargo being stored in a given shed.

83. Apart from the information related to the physical reception and delivery of the cargo, loading lists in the case of exports and cargo manifest in the case of imports can also be keyed into the computer. This information, when received prior to cargo arrival, enables planning of cargo flow through the terminal and, when the goods are being received, can also be used for control purposes (e.g. completeness of the consignment, its identification etc.). Cargo arriving from or for the same vessel can be stored in different sheds and also in different berths or pass directly from/to the ship without usage of storage facilities (direct route). To include within the system records of all cargo passing through the terminal and to avoid confusion in information updating, it is necessary to have one central point for data entry of cargo manifests and loading lists, e.g. the section responsible for planning/supervising storage operations at the terminal.

84. This section, through its computer terminal, would record and keep up-to-date manifest and loading list information and use recorded data for planning purposes. Individual consignments can be assigned to particular shed areas or can be classified as direct route cargo. A plan of storage can easily be printed and distributed among quay and ship supervisors and can also be made available from the sheds' computer terminals for an on-line enquiry and printing. The planning/supervising section also has direct access via its computer terminal to the storage details of consignments in each of the sheds/yards of the terminal.

85. When planning the implementation of the conventional cargo control system, in the same way as for the container tracking system, it is worthwhile to analyze the possibility of direct exchange of computerized data with principal customers, and especially with shipping lines. Obtaining import cargo manifests in a form readable by port computer will significantly reduce time pressure and efforts required for assuring timely preparation of the discharging operation.

C. Basic assumptions and definitions

86. The following assumptions are made for the further description of the system:

- There exist shed/yard documentation offices responsible for keeping records of all cargo received or delivered;
- The shed documentation offices which may work for a group of sheds/yards also perform documentation functions for direct route cargo;
- There is a section in the operations department responsible for planning/supervising of storage at the level of the whole terminal;
- "Unique reception/delivery number" is a unique number assigned to each receipt or delivery of cargo within a terminal. This provides clear identification of the consignment and its reception and delivery. The following can be the structure of a unique receipt/delivery number:
  YY/NNNNNN/CC
  YY - the last two digits of a year;
  NNNNNN - consecutive number of the consignment received in the port within a year;
  CC - consecutive number of receipt or delivery for the consignment.
  The unique receipt/delivery number can be controlled/assigned by computer;
- "Customer" signifies an exporter/importer, shipping line or its agent responsible for movement of the cargo within the cargo terminal;

- "Direction of traffic" means the direction of cargo flow (transit, trans-shipment, import, export);

- "Type of cargo" means code of cargo according to a classification required in a given port for periodical analysis of the flow of cargo;

- "Consignment" means a cargo to be loaded on board or received from a vessel and identified under one bill of lading.

  Consignment data structure:

  General data - vessel, voyage number, inbound or outbound direction, port of loading (inbound) or port of discharge (outbound), customer responsible for movement of a cargo within the port, direction of traffic, type of cargo, B/L number (inbound) or loading list position number (outbound), marks on cargo;
  For each type of packing - type of package, number of pieces, weight, volume, abbreviated description if required.

  One consignment can be stored in various storage areas (sheds and sections of the sheds).

- Designed organization of the system assumes that all shed/yard documentation sections as well as the storage planning/supervising section are equipped with computer terminals (screen, keyboard and printer) having access to the common information files.

D. Organization of the flow of information within the system

Export procedures

87. The shipping line submits a loading list of all cargo to be loaded on board a given vessel. The list should specify a port of discharge and contain a basic description of cargo such as: marking of the cargo; type of cargo and brief description; type of packages; number of pieces; weights and volume; customer involved; special instructions for handling. Individual consignments are identified by loading list position number.

88. The loading list is recorded in the computer system by the planning/supervising cargo storage section at the terminal and is used by this section for assigning storage areas to individual consignments. Finally, the list, in addition to the information obtained from the shipping line, will also contain for each consignment an indication of the direct-route or indirect-route cargo and, for the indirect-route cargo, the shed and sections assigned for storage. For direct-route cargo, remarks referring to the means of transport can be recorded.

89. The information can be updated or corrected according to changing requirements. The current state of the loading list can be viewed or printed in the planning section terminal and also in any of the computer terminals located in the shed documentation offices.

90. When cargo is received in the shed, the export consignment data are recorded by the shed documentation office using documents supplied by the shipper or the shipper's agent. Loading list records can be recalled for control purposes or to facilitate data entry on the reception of the consignment. The consignment is assigned a unique reception number. Data are cross referenced, i.e. the loading list position is recorded in the reception record and the reception number is recorded in the loading list information.

91. The scope of the information recorded by the shed office covers vessel, voyage number, port of discharge identification, loading list position, description of cargo according to types of packages (pieces, weights, volumes) and the area of storage used (shed and its sections). One consignment can be split up into various storage areas.

92. On reception, cargo is tallied and if differences between the carriers' documentation and the result of tallying exist, these are recorded in the consignment records. An appropriate receipt document (e.g. dock receipt) can be printed using the shed computer terminal.

93. Accumulated data about cargo for a given vessel can be reviewed on screen or printed using the shed or the shed supervisor's computer terminal, for planning of the loading operations. A list of all the consignments for a given vessel, classified by storage area can be produced to facilitate

loading sequence planning. After assigning the hatch and loading sequence numbers to the consignment records, the hatch lists can be printed. The same information that is used for the hatch list printing can be used for the tally sheets printout for the control of loading on board.

94. After loading procedures have been finished and the data from the relevant tally sheets have been entered into the system, the final recapitulation of the vessel can be obtained showing discrepancies between the cargo loaded on board and that actually received in a port for a given vessel.

Import procedures

95. Prior to vessel arrival, the cargo manifest and stowage plans are received by the planning/supervising section from the shipping line or its agent. Data referring to particular consignments are introduced into the computer and used for planning purposes. The consignments are identified by vessel, voyage number, port of loading and B/L number. The description of the cargo consists of the same elements as for the loading list in the export procedures. With the ship's stowage plan, the hatch numbers, discharging sequences, storage areas and cargo for the direct route can be planned and recorded within the computer file. The hatch lists and tally sheets for discharging purposes can be printed out by the computer.

96. Cargo, when discharged, is tallied and stored in the planned area. An import consignment record for reception is created, reflecting cargo discharged according to tallies. At the end of discharging, the recapitulation report showing discrepancies between cargo manifested and discharged according to tallies can be printed out from the computer files.

97. Finally, the consignments are gradually delivered to the consignees. Each time a delivery take place the shed section creates a delivery record in the computer file based on quantitative data from the appropriate delivery tally sheets.

Direct route cargo

98. For planning purposes, the planning section updates cargo manifests and loading lists with direct route indicators. Hatch lists and tallies for direct route cargo can be produced in the same way as for indirect cargo. Appropriate delivery/receipt documents together with tally data are the base for recording the physical movement of this type of cargo by the appropriate shed documentation office (or a separate documentation point) within a computer file. The data recorded for each consignment are of the same structure as for indirect reception of the cargo in the shed.

Daily cargo movement register

99. The files of the system contain all receptions and deliveries of all the consignments passing through the terminal. The information can be used for daily printout of a register of the movement of cargo controlled by the shed documentation offices. This register can replace the manual register maintained by the shed clerk.

Export consignments clearance (outbound vessel recapitulation)

100. After loading operations are completed, a statement of any difference between the cargo received for a given vessel and that loaded can be printed. This balance will be calculated on the basis of the number of units and weights for each consignment received for or loaded onto a vessel. The information for individual consignments can be adjusted by correction notes if discrepancies occur and the records finally pass to the archive file for future review or printout. The information required for correction notes is similar to that for ordinary reception and delivery in the shed.

101. The types of possible correction notes (explanations of the reasons for imbalances between receipt and loading), if they are to be processed by the system, should be established according to local practices and requirements. Surplus export cargo can be introduced for a new vessel voyage by agreement with the exporters, or temporarily maintained within the system as cargo awaiting assignment to a particular vessel.

Import consignments clearance

102. This report can be obtained on request and indicates consignments received from a given vessel and delivered or waiting for delivery inland. Final clearance of the consignment can be performed in a way similar to export clearance, using correction notes.

E. Brief characteristic of the outputs

103. The following outputs can be obtained on request, either on the screen or in printed form.

Daily register of receptions/deliveries of cargo

104. Lists all the receipts and deliveries within a day. The output is organized by day/shift, and unique reception/delivery number.
Basic data: vessel, voyage number, inbound/outbound indicator, port of loading/discharge, customer, direction of traffic, type of cargo, B/L number or loading list position number, marks on cargo, unique reception or delivery number, date/shift, clerk responsible, carrier, type of packing, number of pieces, weight, volumes, storage area (shed and section of the shed) or direct route indicator, description of cargo, special remarks.

Manifest review

105. Allows the review of data according to the current content of the manifest including the planned storage areas and whether direct/indirect cargo. The review is used for daily planning/supervision purposes. The output is organized by vessel, voyage number, port of loading, B/L number.
Basic data: vessel, voyage number, port of loading, B/L number, customer, route indicator, direction of traffic, type of cargo, type of packing, pieces, weights, volumes, brief cargo description, shed and section planned, remarks.

Loading list review

106. Allows the review of data according to current content of the loading list, including the planned storage areas and whether direct/indirect cargo. It is used for daily planning/supervising purposes. The output is organized by vessel, voyage number, port of discharge, loading list position number.
Basic data: vessel, voyage number, port of discharge, loading list position number, customer, route indicator, direction of traffic, type of cargo, type of packing, pieces, weights, volumes, brief cargo description, shed and section planned, remarks.

Current list of consignments within the sheds

107. Lists the cargo currently in the shed according to selected parameters: shed, vessel, voyage number, inbound, outbound, customer. The list can also be limited to individual consignments. It is used for daily control purposes by both the sheds and planning/supervising section.
Basic data: vessel, voyage number, inbound/outbound indicator, port of loading/discharge, customer, direction of traffic, type of cargo, B/L number or loading list position number, marks on cargo; for each receipt/delivery: unique receipt or delivery number, date/shift, clerk responsible, carrier, type of packing, number of pieces, weight, volumes, storage area (shed and section of the shed), description of cargo, special remarks; total balance of pieces and weights.

List of direct route cargo

108. Lists all direct-route cargo loaded on board or discharged from a given vessel according to the documentation section records. The list is produced by vessel, voyage number and ports of loading or discharge, depending on inbound or outbound direction. It is used for daily control and for vessel clearance purposes.
Basic data: vessel, voyage number, inbound/outbound indicator, port of loading/discharge, customer, direction of traffic, type of cargo, B/L number or loading list position number, marks on cargo, unique receipt number, date/shift, clerk responsible, carrier, type of packing, number of pieces, weight, description of cargo, special remarks.

Hatch list / tally sheets

109. Lists all consignments within sheds for a given vessel, voyage number, inbound/outbound direction, classified by hatch number, and loading/discharging sequence number. The list can be obtained in two stages. First, details of the storage area of the relevant consignments are extracted from the cargo file and classified. Extracted information on screen or in printed form can be used as a basis for planning. After assignment of hatch numbers and the desired loading/discharging sequence by the planning section, both hatch lists and tally sheets can be printed.
Basic data: vessel, voyage number, inbound/outbound indicator, port of loading/discharge, B/L number or loading list position number, marks on cargo, type of packing, number of pieces, weight, volumes, storage area (shed and section of the shed), description of cargo, special remarks for handling (e.g. heavy lifts, extra lengths, etc.).

Outbound vessel recapitulation

110. Lists all consignments according to the loading list received from the shipowner and the cargo loaded according to the documentation section records. The list is organized by vessel, voyage number, port of discharge and loading list position.
Basic information: - *according to loading list data:* loading list position, customer, brief description of cargo, direct/indirect route indication, type of package, pieces, weights, volumes; - *according to loading data:* type of package, pieces, weight, volumes.

Inbound vessel recapitulation

111. The organization and scope of the output is similar to the outbound vessel recapitulation. The output is based on cargo manifest and shed reception records.

Outbound consignments clearance

112. Lists all consignments received for a given vessel and the cargo loaded according to the documentation section records. The output is used by the shed office for the final consignment clearance. The list is organized by vessel, voyage number, port of discharge and loading list position.
Basic information: vessel, voyage number, port of discharge, loading list position number, customer;
- receipts: unique receipt number date/shift, clerk, brief description of cargo, type of package, pieces, weights, volumes, shed/yard;
- deliveries: unique delivery number, date/shift, clerk, brief description of cargo, type of package, pieces, weight, volumes, shed/yard;
- balance for loading list position: pieces, weight.

Receptions and deliveries may be updated by correction notes explaining existing differences.

Inbound consignments clearance

113. Lists all the consignments discharged and the consignments delivered to the customers from a given vessel. The output can be produced for a vessel, voyage number or an individual B/L. Organization and scope of the output is similar to the outbound consignment clearance.

Enquiry about an individual consignment within a terminal

114. The enquiry can be made using either vessel, voyage, inbound/outbound, port, B/L or loading list position number or unique reception/delivery number. The scope of the output information is the same as for inbound/outbound consignment clearance.

Cargo by customers and time of storage

115. Lists details of the consignments by customer together with time of storage calculation. The output is organized by customer and time of storage. It can also be produced for a given customer or consignment or be limited to cargo stored more than a given number of days. The output can be used both for monitoring time of storage and for billing purposes.
Basic information: customer, vessel, voyage number, B/L or loading list position number, description of cargo;
receipt information: type of package, pieces, weight, volumes, date/shift, shed/yard;

delivery information: same as for receipt information;
time of storage: tonnes stored for different time intervals.

Daily use of storage facilities

116. Gives totals of tonnes of cargo stored in each shed and yard by the end of the day/shift. It can be used for daily work of the planning/supervising section. Basic information: shed/yard, usable storage area, estimated total capacity in tonnes, tonnes stored: inbound, outbound, total, percentage of estimated total capacity used.

Monthly statistical indicators

117. On the basis of data accumulated for cargo control purposes, the following monthly indicators can be obtained:

- Tonnes discharged/loaded according to direction of traffic (import, export, transit, trans-shipment);
- Tonnes discharged/loaded according to type of cargo;
- Tonnes discharged/loaded according to direct/indirect-route cargo;
- Tonnes stored each day within a month;
- Average length of stay of cargo by type of traffic.

Monthly data can be accumulated for longer periods of time, e.g. quarters and years.

F. Brief description of basic input information

Loading list

118. Basic data: vessel, voyage number, port of discharge, customer, direction of traffic, type of cargo, loading list position number, marks on cargo; for each type of package: type of packing, number of pieces, weight, volumes, brief description, remarks for special cargo handling (e.g. dangerous class, reefer temperatures, etc.). During the planning of cargo loading, individual consignments are updated by the planning section with the direct/indirect route indicator and the storage area assigned (shed/yards and sections).

Cargo Manifest

119. Basic data: vessel, voyage number, port of loading, customer, direction of traffic, type of cargo, B/L number, marks on cargo; for each type of package: type of packing, number of pieces, weight, volumes, brief description, remarks for special cargo handling (e.g. dangerous class, reefer temperatures, etc.). During the planning of cargo discharging, individual consignments are updated with the direct/indirect route indicator and storage area assigned (shed/yard and sections) by the planning/supervising section.

Receiving/delivery inland (dock receipt, delivery order, tally information)

120. Basic data: vessel, voyage number, inbound/outbound indicator, port of loading/discharge, customer, direction of traffic, type of cargo, B/L number or loading list position number, marks on cargo, unique reception or delivery number, date/shift, clerk responsible, carrier, direct/indirect route, type of packing, number of pieces, weight, volumes, storage area (shed and section of the shed), description of cargo, special remarks.

Correction notes (clearance of the consignments)

121. Basic data: vessel, voyage number, inbound/outbound indicator, port of loading/discharge, customer, B/L number or loading list position number, type of correction and reference to the source document for correction, date/shift, clerk entering data, type of packing, number of pieces, weight, shed, description of cargo, remarks.

Discharging/loading the vessel (tally data)

122. Basic data: vessel, voyage number, inbound/outbound indicator, port of loading/discharge, customer, direction of traffic, type of cargo, B/L number or loading list position number, marks

on cargo, unique receive or delivery number, date/shift, clerk responsible, carrier, direct/indirect route, type of packing, number of pieces, weight, volume, storage area (shed and section of the shed), description of cargo, special remarks.

G. Basic files of the system

Manifest file

123. Contains information about import cargo expected in port from a given vessel. The file is created separately for each vessel/voyage number arriving in the port with import cargo. It can be created automatically when received in computer-readable form from the shipping line (direct computer-to-computer transmission, diskette, magnetic tape or computerized telex message). Otherwise the data are keyed in manually from the import cargo manifest and stowage plan of the vessel in the shed planning/supervising section.
Basic data: vessel, voyage number, port of loading, customer, direction of traffic, type of cargo, B/L number, direct/indirect route indicator, marks on cargo; for each type of package: type of packing, number of pieces, weight, volumes, brief description, remarks for special cargo handling (e.g. dangerous class, reefer temperatures, etc.), shed/yard and sections of storage area assigned. The file is maintained until final clearance of the cargo discharged from the vessel.

Loading file

124. Contains the information about cargo from the loading list. The file is created for each vessel/voyage number for export cargo. The organization and function of the file is similar to that of the manifest file.
Basic data: vessel, voyage number, port of discharge, customer, direction of traffic, type of cargo, loading list position number, direct/indirect route indicator, marks on cargo; for each type of package: type of packing, number of pieces, weight, volumes, brief description, remarks for special cargo handling (e.g. dangerous class, reefer temperatures, etc.), storage area assigned. The file is maintained until final clearance of the export cargo for a given vessel (export vessel recapitulation).

Cargo file

125. This is the main file within the system. It contains all the receptions and deliveries for import and export cargo controlled by one shed documentation office.
Basic data: vessel, voyage number, inbound/outbound indicator, port of loading/discharge, customer, direction of traffic, type of cargo, B/L number or loading list position number, marks on cargo;
for each receipt/delivery: unique receipt or delivery number, date/shift, clerk responsible, carrier, direct/indirect route, type of packing, number of pieces, weight, volumes, storage area (shed and section of the shed), description of cargo, special remarks for handling (e.g. dangerous class, reefer temperatures, etc.). Correction notes for receipts and deliveries, which refer to both pieces and weights, should be used to update this file. The information in the file is maintained as long as a particular consignment is not cleared completely - the weight and pieces balance equals zero.

Stowage factors file

126. The file contains the combinations of packing and cargo types most commonly occurring in daily operations. It is based on ship stowage factors adjusted to the local shed/yards storage practices and expressed in cubic meters per tonne. This is maintained and used by the shed supervisors for daily planning purposes.

Sheds/yards file

127. The list of sheds and yards includes the usable storage area in square meters and the estimated holding capacity in tonnes, considering average type of cargo usually stored.

Cargo archive file

128. The file contains information about cleared consignments removed from the cargo file. It is used for historical enquiries and statistics.

Code file

129. This file maintains for control purposes the list of all codes which appear within the system. The main codes are:

Ships code - Lloyd register or radio call code;

Port codes - based on ISO country codes and IATA location codes;

Packing types - based on United Nations classification;

Cargo types - based United Nations classification;

Dangerous cargo - IMO IMDG dangerous cargo classification;

Direction of traffic - import, export, transhipment, transit;

Customer codes - list of mnemonics of individual customers responsible for cargo movement within a terminal; also includes carriers.

IV. Ships operational control system

A. Objective and scope of the system

130. The objective of the system is to provide direct support for the daily work of the Operations Department at the port. The system provides an easy way for the recording and retrieval of the information related to the daily allocation of the berths and monitoring of the vessels' loading/discharging operations.

131. The basic tasks of the system are the following:

- To keep up-to-date records on the incoming/outgoing ships' schedules;
- To provide current information about use of berths and progress of ships operations;
- To provide analysis of ships' time in the port;
- To keep historical records of ships operations in the port.

132. The system is based on operational information obtained from the berth supervisors, supplemented with data received from the Harbour Master's Office and, if required, from stevedoring companies. Required data should be entered into the system at least daily, to reflect the current operational situation at the beginning of each day. The basic scope of the information refers to the time of ships' movements, possible delays in operations, place of berthing, tonnage and type of cargo loaded/discharged and the number of gangs used. The system will also maintain in its files the basic characteristic of each berth at the port, for example its length, draught, main cargo handling equipment (e.g. cranes) and capacities of cargo storage areas.

133. The system is operational as opposed to administrative in nature and is used to reflect the current situation in the port. Thus it frequently uses data without immediate support of appropriate documents. However, it is of great importance that all such data be later verified against appropriate documents when these are available to assure reliability of the information accumulated.

134. The processing can be done using a PC-type computer located in the Operations Department. The operation of the system may require full time assignment of a clerk responsible for daily information collection and data entry, as well as for system operation.

B. Flow of information within the system

135. The flow of information is concentrated around the movements and activities of the ships. Whenever a ship's visit to the port is announced, basic information referring to her physical characteristic (name, length, draught, beam, GRT, NRT, DWT, number of hatches, cargo handling equipment available, Lloyds register number, agent responsible, etc.) is entered into the system. These data are recorded only once, when the ship appears in the computer files for the first time. For each subsequent call of the ship, the information will be recalled from the system and updated if required. Additionally to this information, data referring to the type and tonnage of cargo to be discharged and loaded, as well as ETA and planned berth, are recorded. The information can be adjusted daily according to the changing situation.

136. Daily, for each ship at the port, her activities during the last 24 hours should be reported and recorded within the system. The following data can be recorded:

- Date/time arrival at the port;
- Date/time start of waiting for berthing, cause;
- Date/time berthing;
- Date/time start of shifting (changing the berths);
- Date/time start of idle, cause;
- Date/time loading/discharging, number of gangs working, tonnes handled, number of containers if applicable;
- Date/time leaving the berth;
- Date/time start of waiting to leave port, cause;
- Date/time leaving the port.

137. To enable an analysis of the delays in ship operations, a list of typical causes should be defined, considering local condition at a given port. [1] In general terms, each of the causes of non-operational time should fall into one of the three broad categories: attributed to ship, attributed to port or attributed to external factors (e.g. bad weather).

138. Based on the recorded data, the following main printouts can be obtained at the begining of each day and distributed among involved port sections/departments and also to the principal port customers:

- The ships expected at the port - showing both ETA, and cargo and ship's basic characteristics;
- The ships at the berths - showing current position of the ships at the berths, together with such data as cargo already discharged and loaded, cargo waiting to be discharged and loaded, gangs used, etc.

Data accumulated within the system, can be used for a monthly analysis of berth occupation and an analysis of the time of the ship operation.

139. Data about vessel operations can be stored for a longer period of time (e.g. 1-2 years) and reviewed on screen or on paper if required. The stored information can also be a source for a statistical analysis over a longer period of time.

C. Basic outputs

Review of ship's operational data

140. The output provides on request a review of the log of all the operational events concerning the selected vessel on screen or in the form of a printout from the time of her announcement at the port until final sailing. The output may refer to a ship currently in the port or to historical data.

Basic data :

- voyage data:
ship identification, name, voyage number, port call sequence number, types of cargo and tonnes to be discharged, types of cargo and tonnes to be loaded;

- movement data:
date, time announced, planned berth number;
date, time arrived, planned berth number;
date, time waiting for berth, cause;
date, time berthed, berth identification;
date, time in operation, berth number:
loaded types of cargo, tonnes, gangs used;
loaded number of containers by size;
discharged number of containers by size;
discharged types of cargo, tonnes, gangs used;
date, time idle at the berth, berth number, cause;
date, time shifted from berth, berth number, cause;
date, time end of cargo operations, berth number;
date, time waiting for sailing out, cause;
date, time left the port.

Review of ship's characteristics data

141. The output provides on request a review of the basic characteristics of the selected vessel. Basic data: name, shipowner, agent, length, beam, max. draught, GRT, NRT, DWT, number of hatches, cargo handling equipment available, Lloyds register number, radio call code, flag, date of the last call.

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1 See *Manual on a uniform system of port statistics and performance indicators* (UNCTAD/SHIP/185/Rev.2), 3rd edition; Geneva 1987; page 152.

Review of berth's data

142. The output provides on request a review of the basic characteristics of all the berths in the port.
Basic data: berth number, length, draught, adjacent sheds and open yards together with their storage capacities, cranes and their capacities, remarks referring to cargo handling.

Daily printouts

Arrival list

143. Reflects all the ships announced as arriving at the port.
Basic data: name, voyage number, ETA, type of cargo and tonnes to be discharged, type of cargo and tonnes to be loaded, characteristics of the ship (length, draught, number of hatches etc.).

Ships waiting for the berth

144. Reflects the ships arrived at the port and waiting for berthing.
Basic data: name, voyage number, date and time arrived, days waiting, berth planned, type of cargo and tonnes to be discharged, type of cargo and tonnes to be loaded, characteristics of the ship.

Ships at the berths

145. Reflects the ships according to the berthing place. The printout is organized by berths. Berths not occupied will also be printed.
Basic data: berth number, ship's name, voyage number, date berthed, type and tonnes of cargo to be discharged, accumulated tonnes discharged, tonnes discharged in the last day, type of cargo and tonnes to be loaded, accumulated tonnes loaded, tonnes loaded in the last day, number of gangs working the last day, accumulated times: at the berth, in operation, idle.

Time analysis of the vessels operation

146. Provides time analysis for the vessels which have been operated within a given period of time (usually a month). The printout can also be obtained on request for a selected vessel.
Basic data: vessel, voyage number, types of cargo and tonnes discharged, types of cargo and tonnes loaded, total tonnes handled, total time at port, tons handled per hour (total tonnes divided by the total time at port), number of gangs/shift available, number of containers handled by size, time of operation at the berth, idle time: attributed to port, to ship and to other.

Berth occupancy report

147. Provides information about the use of berths within a given period of time (usually on a monthly basis).
Basic data: berth number, time vacant, time occupied working, time occupied not working. The indicators are calculated in hours and in percentage.

148. The above monthly printouts can also be obtained accumulated within a year.

D. Basic inputs and files of the system

149. The structure and the contents of the basic input information is the same as the information maintained in the main files of the system.

Ship's operational file

150. This file contains all data about the ship's operations and idle time since her announcement at the port until final sailing.
Basic data maintained:

- voyage data:
ship identification, voyage number, port call sequence number, types of cargo and tonnes to be discharged, types of cargo and tonnes to be loaded;

- movement data:

date, time announced, planned berth number;
date, time arrived, planned berth number;
date, time waiting for berth, cause;
date, time berthed, berth identification;
date, time in operation, berth number:
loaded types of cargo, tonnes, gangs used;
loaded number of containers by size;
discharged types of cargo, tonnes, gangs used;
discharged number of containers by size;
date, time idle at the berth, berth number, cause;
date, time shifted from berth, berth number, cause;
date, time end of cargo operations, berth number;
date, time waiting for sailing out, cause;
date, time left the port.

Ships characteristic file

151. The file contains fixed data about all ships calling at the port. The information is introduced only once into the system and can be recalled and revised whenever required.
Basic data maintained: name, line, agent, beam, length, maximum draught, GRT, NRT, DWT, number of hatches, cargo handling equipment available, Lloyds register number, radio call code, flag, date of the last call.

Berths file

152. This file contains the characteristics of all the berths within the port.
Basic data maintained: berth identification, length, draught, adjacent sheds and open yards together with their maximum storage capacities, cranes and their capacities, remarks referring to cargo handling. The file can be updated with available storage capacities estimated daily by the shed supervisors.

Archive file

153. The file contains the information retrieved from the ships operation file after the vessels have sailed from the port. The information is maintained for a period of 2-3 years.

Code files

154. Basic codes within the system:

Ship code - Lloyds register and radio call code;
Port code - based on ISO country and IATA location codes,
Agent code - mnemonic or numerical codes assigned to agent responsible for the vessel,
Shipowner code - mnemonic or numerical code for the shipowner,
Berth code - mnemonic or numerical identifications of the berths;
Type of cargo code - main types of cargo handled at port;
Causes of delays in operation of the vessel - types of typical reasons of delays in ships operations classified into three broad groups: attributed to ship, attributed to port or due to external reasons.

Annex 1

SUGGESTIONS FOR A COMPREHENSIVE TRAINING PROGRAMME

Suggestions are made below for a comprehensive training programme to cover the management training requirements of a typical middle-size port in the field of computerization. Such a programme has to be adapted to the situation prevailing in each port. It should therefore be finalized after a training analysis has been carried out. Usually it will be necessary to inform and sensitize the top management, and then to actually train the staff directly involved in the operation of the computer centre and in the implementation of the operational and administrative applications.

1. Introduction to computing for port managers

Duration: 1-2 days.

Audience: high-level management taking decisions to introduce computers in the organization.

Objective:

- to present an overview of the computer applications in ports,
- to provide some basic knowledge referring to purchase and installation of the computer services in the port.

Outline:

- company information systems and computers,
- brief overview of typical operational and administrative computerized systems in ports,
- brief review of developments in hardware, software and telecommunications,
- setting up computing services within the port:
- purchase of the software and hardware,
- organization of the computing services,
- training requirements.

2. Organization of the computing services

Duration: 4-5 days.

Audience: middle-level management responsible for organization and co-ordination of the computing services in the port.

Outline:

- port information systems and computers,
- role of computer in information system,
- brief revision of typical port computerized applications,
- current developments in equipment,
- software tools development,
- organization of the Computer Centre,
- systems development activities,
- operational activities,
- maintenance activities.

3. Basic port operational applications

Duration: 5 days.

Audience: higher and middle-range management - Traffic and Operations Division.

Objective: to give to the managers sufficient background to define requirements for the computerized information systems in their local environment,

Outline: characteristics of the most typical systems, giving for each of them benefits, objective and scope, organization of the flow of the informations, basic requirements for the systems installation:

- container tracking,
  - data about containers in port,
  - loading/discharging list preparation,
  - gate in/out documentation,
  - data exchange with customers.
- general cargo control system,
  - cargo tracking from reception in port till delivery,
  - control of space available in sheds and yards,
  - providing information about cargo to customers.
- ships operation control system,
  - current control of berth allocations,
  - ship's movement record from arrival in the port till sailing (time and activity),
  - control of the stevedoring operations,
  - maintenance of the historical data referring to the ships' calls in the port.
- basic statistics and performance indicators,
  - basic indicators according to UNCTAD uniform port statistics and performance indicators,
  - input data produced as by-product from operational systems described above.
- port information services to customers,
  - access to the data bank created by the operational systems can be offered to customers, making the port services more attractive and efficient; also organization of direct exchanges of computerized manifests and loading/discharging lists between port and shipping companies will provide benefits in terms of shorter and error-free processing of cargo documentation.

4. Basic port administrative applications

Duration: 5 days.

Audience: higher and middle-range managers - Administration, Finance, Engineering Divisions.

Objective: to give the administrative managers sufficient background to define the requirements for the computerized information systems in their local environment.

Outline: characteristics of the most typical systems, giving for each of them benefits, objective and scope, organization of the flow of information, basic requirements for installation.

- personnel/payroll system,
  - personnel data, payroll calculation and printout, labour cost analysis,
- control of spares and consumables system,
  - stores accounting and inventory, cost analysis, purchase control,
- fixed assets system,
  - inventory, depreciation, maintenance and repair records,
- invoicing system,
  - billing for all types of services - basic information comes from operational systems,
- accounting system.
  - records of journals and ledgers, balance calculation.

Annex 2

CALCULATION OF CHECK DIGIT FOR CONTAINER IDENTIFICATION NUMBER

The container identification number consists of an owner code (four letters), a serial number (six numbers) and a check digit (one numeral). To each letter of the owner code, a numerical value is allocated according to the following table:

A - 10	I - 19	Q - 28	Y - 37
B - 12	J - 20	R - 29	Z - 38
C - 13	K - 21	S - 30	
D - 14	L - 23	T - 31	
E - 15	M - 24	U - 32	
F - 16	N - 25	V - 34	
G - 17	O - 26	W - 35	
H - 18	P - 27	X - 36	

The individual numerical values of the container identification code are multiplied by the following weighting factors:

1, 2, 4, 8, 16, 32, 64, 128, 256, 512 .

The sum of the results of the multiplications is divided by 11.

The remainder of this division is the check digit.

In both cases when the remainder is equal to 10 or to 0 the check digit is 0. To avoid repetition of the check digit, it is suggested to avoid serial numbers that give remainders of 10.

The following is an example of a check digit calculation:

	Owner				Serial number					
Container identification:	A	B	C	U	2	0	0	0	1	1
Values assigned:	10	12	13	32	2	0	0	0	1	1
Weighting factors:	1	2	4	8	16	32	64	128	256	512

Sum of values x factors: 10 + 24 + 52 + 256 + 32 + 0 + 0 + 0 + 256 + 512 = 1142

1142 / 11 = 103, remainder 9. Therefore the check digit is 9.

The container identification number, including the check digit is ***ABCU 200011 9***.